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Notes on Amphisbaenids (Amphisbaenia, Reptilia). 13

A Systematic Review of *Anops* Bell, 1833

By Carl Gans[1] and Charlyn Rhodes[2]

INTRODUCTION

Distinctive amphisbaenids of the monotypic genus *Anops* Bell, 1833, have been reported from a number of localities from Brazil to Argentina. Various authors (Freiberg, 1939; Koslowsky, 1898; Marelli, 1924; Ringuelet and Aramburu, 1957) have listed several undocumented ranges from the Chaco south to Río Negro, but no documented statement of variation or range exists. The single species, *A. kingi*, has been mentioned in several anatomical papers, because it seems to represent the South American species with the most extreme cephalic compression. The following summary provides a standardized redescription (Gans and Alexander, 1962) based on specimens from American and European museums, furnishes nomenclatorial comments, documents the range far south into Argentina, and summarizes the literature.

We are grateful to the following curators of collections for the loan of specimens (identified by abbreviations in parentheses): Mr. Charles M. Bogert of the American Museum of Natural History (A.M.N.H.); Dr.

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After the manuscript had been submitted it proved possible to see additional materials through the courtesy of the following curators of collections. The specimens have been recorded under the heading Locality Records, but the data on them were not considered in the section on geographic variation: Drs. Paulo E. Vanzolini and A. Stanley Rand of the Departamento de Zoologia, São Paulo, São Paulo, Brazil (D.Z.); Dr. Kenneth Hayward of the Instituto Miguel Lillo, San Miguel de Tucuman, Argentina (I.M.L.); Dr. Oswaldo A. Reig of the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina (L.I.H.U.B.A.); Drs. Jorge A. N. Cranwell and José M. Gallardo of the Museo Argentino de Ciências Naturales "Bernardino Rivadavia," Buenos Aires, Argentina (M.A.C.N.); Drs. Miguel A. Klappenbach and Braulio Orejas-Miranda of the Museo de Historia Natural de Montevideo, Uruguay (M.N.H.N.); Mr. Thales de Lema of the Museu Rio-Grandense de Ciências Naturais, Pôrto Alegre, Rio Grande do Sul, Brazil (M.R.C.N.); Dr. Celso P. Jaeger and Mr. Silvio Mendes Correa of the Instituto de Ciências Naturais, Universidade de Rio Grande do Sul, Pôrto Alegre, Rio Grande do Sul, Brazil (U.R.G.S.); and Dr. Raul Vaz-Ferreira of the Departamento Zoologia Vertebrados, Facultad de

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GENUS *ANOPS* BELL

Anops BELL, 1833, p. 99. Type species: *A. kingii*, by monotypy.
Anopus STEINDACHNER, 1867, p. 55. *Lapsus* for *Anops*.
Anopsibaena STEJNEGER, 1916, p. 85. *Nomen novum* for *Anops* Bell.

Stejneger (1916, p. 85) proposed *Anopsibaena* because he believed Bell's name to be preoccupied by *Anops* Oken, 1815. Names in volume 3 of Oken's "Lehrbuch" are now unavailable (Hemming, 1956, p. 3). The ruling permits us to return to the original name, used in all the older literature.

Vanzolini (1951, p. 115) provided the following generic definition (summarized from Vanzolini, MS): Snout strongly compressed, raised into a keel, which is formed by the premaxilla, which separates the nasals. Basipterygoid processes, partes posteriores choanarum, and supratemporals absent. Quadrate rod-like. Dentition 7;3;7. Rostral shield enormous. Nasal shields not fused to rostral.

Anops kingi Bell

Anops kingii BELL, 1833, p. 99; 1835, p. 391. Terra typica: "In Americâ Australi." Type apparently lost.
Amphisbaena galeata WIEGMANN, 1834, p. 21. GRAY, 1844, p. 72. Manuscript name without description, hence a *nomen nudum*.

NOTES ON SYNONMY: A check of the catalogues and other documents in the British Museum (Natural History) provided no evidence that the typical specimen had ever been deposited there, nor did Gray (1844) list specimens in this collection. Clearly the type is lost. It is fortunate, therefore, that the initial (preliminary) diagnosis (1833, p. 99) and the more extensive and illustrated description (1835, p. 391, pl. 16, fig. 1) published later leave no doubt concerning the identity of the type. Identification rests on the laterally compressed head, stumpy tail, general proportions, and scale pattern. No counts were given.

The name *galeata*, which remains a *nomen nudum*, apparently was on the label of a specimen in the Berlin museum and cited from this by Wiegmann (1834, p. 21) and from him by Gray (1844, p. 72).

FIG. 1. Sketch map of the range of *Anops kingi*, indicating localities mentioned in text. Solid circles give site from which specimens are available; open circles represent literature records. The large letters identify those states of Argentina mentioned in the literature as included in the range of the species, regardless of whether specimens have been available for examination.

DIAGNOSIS: An amphisbaenid with a large, swollen, rostral shield that ascends the dorsal aspect of the strongly compressed snout almost to the level of the eye. The shield is covered by a thick keratinized layer (par-

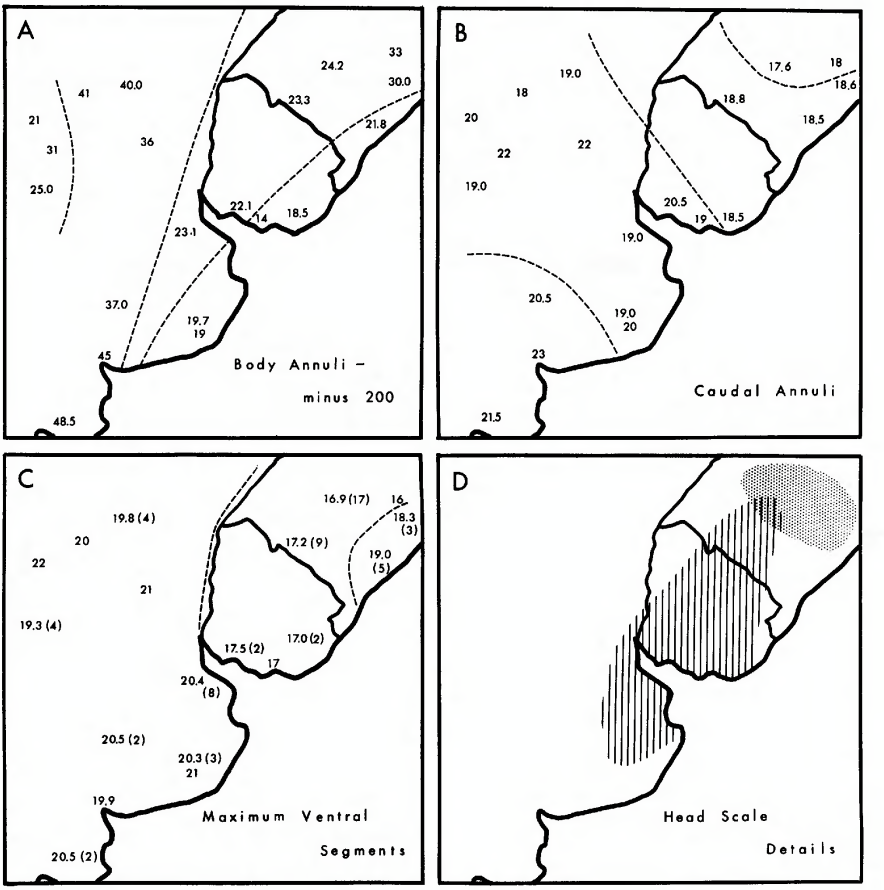

FIG. 2. *Anops kingi.* Sketch maps (traced from the central portion of fig. 1), to show the discordant pattern of character variation. In general decimals are omitted from samples of fewer than three specimens. A. Counts of body annuli, with the first numeral (=2) omitted. Dashed lines here, as in B and C, added only to facilitate visualization; they are obviously not calculated. B. Number of caudal annuli. C. Maximum number of ventral segments. Sample sizes are given in parentheses following the means. D. The stippled area shows the occurrence of the head segment pattern coded B (see text) characterized by an enlarged rostral and but a single segment between it and the ocular. The vertical hatching shows the area in which samples exhibit a high frequency of irregular gular patterns.

ticularly in adults); two, more or less complete, rows of segments lie between the ocular and the rostral. There are four round, generally but faintly apparent, precloacal pores; and the tail is cylindrical distally and

faintly swollen, with an autotomy constriction between the sixth and eighth (generally at the seventh) postcloacal annulus. There are 214 to 249 body annuli; 16 to 23 caudal annuli; and 12 to 19 dorsal and 14 to 22 ventral segments to a midbody annulus. The segments behind the postmental are irregular, in almost every case with two teardrop-shaped postgenials in the first row, in some instances followed by a few second postgenials partly inserted along the rear edge of the first row, in others followed by a postmalar row that ordinarily is absent. The dorsum is light brown, markedly countershaded, and the color drops out by segments. The ventral surface of the trunk is yellow.

Geographic Variation: It is not astonishing that this wide-ranging form exhibits considerable local and regional variation. As far as could be determined, this variation is discordant, and the pattern for each character is distinct. Figure 2 shows this graphically for the five systems for which geographic variation is apparent.

1. Body annuli (fig. 2A): This character reveals a series of populations with low counts along the eastern edge of the range, higher counts in populations farther west, a belt of very high counts running from Santa Fé to Río Negro, and a group of populations with intermediate counts in the westernmost Córdoba region.

2. Caudal annuli (fig. 2B): This character shows a gradual but irregular increase in counts from the northeast to the southwest. The trend is most clearly marked at the extremes of the range.

3. Number of segments per midbody annulus (fig. 2C): Because of the variability of segment number between adjacent annuli, we compared only the extremes. Here again there is a general increase in the number of segments from northeast to southwest. A tabulation of minimum numbers of dorsals and maximum numbers of ventrals shows surprising agreement. In each case the Rio Grande do Sul localities of Pôrto Alegre and São Lourenço had medium level counts separated from a region of higher counts (in Argentina) by a zone of low counts lying east of the Río Paraná (in Uruguay and Rio Grande do Sul).

4. Number of dorsal head scales (fig. 2D): Throughout most of the range specimens have two rows of small segments running from nasal to occiput between ocular and rostral (code A in table 1; fig. 4). Specimens from three localities grouped in the extreme northeast of the range show the first row reduced, with one to three small segments, not in contact with the nasal (code B in table 1; fig. 3). Here there is only a single row between the ocular and the very much larger rostral.

5. Arrangement of gular segments (fig. 2D): Most samples show a preponderance of specimens with two rows of postgenial segments.

TABLE 1

DATA FOR SPECIMENS OF *Anops kingi*

Collection and Number	Body, Lateral, and Caudal Annuli	Dorsal and Ventral Segments	Chin Segments	Code	Cloaca	Total Length
V.M. No. 500–6	236+4+(8)21	16/18–21	2+4 –	A	4F+6+12	172+18
B.M. No. 85.2.3.5	229+3+(6)17	14/16–19	2+4 –	A	4F+6+10	102+11
S.U. No. 17291	221+4+(7)20	16–17/20–21	2+5 –	A	4 +7+16	171+21
S.U. No. 17303	217+3+(7)19	15–16/18	2+5+11?	A	4F+6+12	146+18
C.N.H.M. No. 80100	234+4+(6)17	14–15/17–19	2+5+10	B	4F+9+15	212+23
S.M.F. No. 11830	238+2+(7)20	13–16/14–15	2+5+	AB	4F+6+14	166+17
Z.M.U. No. 6829A	230+3+(7)20	15–16/17–18	2+5 –	B	4F+6+12	216+23
Z.M.U. No. 6829B	226+4+(7)19	14/17–18	2+5 –	B	4F+6+11	147+16
A.N.S.P. No. 11354	233+4+(8)18x	15–16/16	2+5 –	B	4 +6+13	186+18x
B.M. No. 86.3.10.2	214+3+(7)18	16–17/18–19	2+5 –	A	4F+6+12	215+25
B.M. No. 86.3.10.3	224+4+(8)x	16/18–19	2+5 –	B	4F+6+12	215+x
B.M. No. 86.3.10.4	215+4+(7)20	14/18	2+5 –	A	4F+6+10	198+23
B.M. No. 86.3.10.5	222+3+(8)19	15–16/18–19	2+6 –	A	4 +6+13	210+23
B.M. No. 86.3.10.6	215+4+(7)17	15–16/19–20	2+5 –	A	4F+6+13	195+20
C.G. No. 1063	226+3+(7)18	14–15/16–17	2+5 –	B	4F+6+11	218+23
M.C.Z. No. 43360	222+4+(6)17	13–15/16	2+2?+10	B	4 +6+11	174+18
M.C.Z. No. 43361	222+3+(7)16	13–14/16–18	2+2? –	B	4F+4+10	189+20
M.C.Z. No. 43362	221+3+(6)17	12–13/16–17	2+2?+11	B	4F+7+13	199+21
M.C.Z. No. 43363	226+3+(7)15	14/15–16	2+2?+11	B	4 +7+13	—
M.C.Z. No. 43364	222+3+(7)18	14/16–17	2+4 +10	B	4F+6+12	155+18
M.C.Z. No. 43365	221+4+(7)17	13–14/15–16	2+5 +10	B	4 +6+12	196+21
M.C.Z. No. 43366	223+3+(7)17	12/14–15	2+2?+10	B	4F+6+11	189+70
M.C.Z. No. 43367	225+3+(6)18	13–14/15–18	2+6 –	B	4F+6+13	148+16
M.C.Z. No. 43368	219+4+(7)x	14–15/16–17	2+2? –	B	4F+6+13	202+x
M.C.Z. No. 43369	223+3+(7)18	14/18–19	2+3 –	B	4F+6+14	172+20
M.C.Z. No. 43369A	[216]	13–14/15–16	2+– +10	B	—	—

TABLE 1—(*Continued*)

Collection and Number	Body, Lateral, and Caudal Annuli	Dorsal and Ventral Segments	Chin Segments	Code	Cloaca	Total Length
M.C.Z. No. 43369B	238+3+(8)20	14–15/15–16	2+4? –	B	4F+6+11	107+12
M.C.Z. No. 43369D	226+4+(7)17	14–15/15–17	2+5 –	B	4F+6+14	152+17
M.C.Z. No. 43369E	227+3+(8)20	14–16/15–16	2+4+ 9	B	4F+6+14	123+14
M.C.Z. No. 43369F	230+3+(6)17	14–15/15–17	2+–+ 9	B	4F+6+13	121+12
M.C.Z. No. 43369G	217+5+(7)19	15–17/17–20	2+4+ 9	B	4F+6+14	109+11
B.Y.U.C. No. 11466	229+4+(7)19	16 — /16–18	2+3? –	A	4F+6+10	165+19
B.Y.U.C. No. 11468	225+4+(7)19	14/18	2+3? –	A	4F+6+10	175+19
B.Y.U.C. No. 11469	220+3+(7)18	14–16/16	2 – –	A/B	4 +6+11	139+16
B.Y.U.C. No. 11470	232+$\frac{2}{3}$+(7)19	12–13/16	2+5 –	A	4 +6+10	153+17
B.Y.U.C. No. 11471	215+3+(8)20	13–14/16–18	2+2? –	A	4F+6+13	111+11
B.Y.U.C. No. 11473	225+3+(8)18	13–14/15–18	2 – –	A	4F+6+10	118+12
B.Y.U.C. No. 11474	218+3+(7)18	14/15–18	2 – –	A/B	4 +6+12	140+16
B.Y.U.C. No. 11475	224+3+(7)x	14/16–17	2+5 –	A	4 +6+11	130+x
K.U.M.N.H. No. 31677	217+4+(7)19	15–16/18	2+4? –	A	4 +6+13	146+16
M.C.Z. No. 3834	219+3+(6)19	12–14/16–19	2+– +9	B	4F+6+12	118+14
C.G. No. 2209	222+3+(7)19	15–16/16	2+2? –	A	4 +6+12	184+21
C.G. No. 2210	215+3+(7)18	14–16/15–18	2+4 –	A	4F+5+11	155+18
Z.M.U. No. 1387	214+3+(7)19	14/16–17	2+5 –	A	4F+6+11	120+13
B.Y.U.C. No. 16148	224+3+(6)20	14/18	2+3? –	A	4F+6+11	200+23
B.Y.U.C. No. 16149	218+3+(7)21	14–15/16–18	2+2?+9	A	4F+6+ 9	148+17
Z.M.U. No. 11340	238+3+(7)21	16/18–19	2+5 –	A	4F+6+12	165+20
Z.S.M. No. 229/33A	240+4+(7)20	17–18/20	2(1)+6 –	A	4 +6+12	175+17
Z.S.M. No. 229/33B	237+3+(7)18	15–16/19–20	2+2? –	A	4F+6+11	105+11
Z.S.M. No. 229/33C	244+3+(7)20	16/19–20	2+3? –	A	4F+6+10	126+13
Z.S.M. No. 229/33D	239+$\frac{4}{3}$+(7)18	15–16/18–19	2+2? –	A	4F+6+11	128+13

TABLE 1—(*Continued*)

Collection and Number	Body, Lateral, and Caudal Annuli	Dorsal and Ventral Segments	Chin Segments	Code	Cloaca	Total Length
B.M. No. 1930.6.7.2	236+3+(7)22	18/20–21	2+5 –	A	4F+6+12	170+20
U.S.N.M. No. 16619	231+3+(8)22	15–18/20	4+4 –	A	4F+8+12	185+21
H.M. No. 4607	241+3+(7)18	14–16/18–20	2+3? –	A?	4F+6+10	177+18
B.M. No. 83.4.14.10	221+3+(7)20	18–19/20–22	2+5 –	A	4F+6+14	145+15
A.M.N.H. No. 65186	222+4+(7)20	15–16/18	2+5 –	A	3 +6+10	154+18
A.M.N.H. No. 65187	237+3+(7)19	18/19–21	2+5 –	A	4F+6+10	172+18
A.M.N.H. No. 65188	223+3+(7)19	15–17/18–19	2+2? –	A	4 +5+10	121+15
A.M.N.H. No. 65189	218+4+(7)18	16–17/18–19	2+5 –	A	4F+7+ 9	133+15
H.M. No. 1940	229+4+(7)20	15–16/20	2+4 –	A	4F+9+ 9	170+21
K. M. No. R-4466	232+3+(7)20	16 — /19–20	2+5 +11	A	4 +6+14	176+20
K.M. No. R-4467	219+3+(7)19	16/20–21	2+5 –	A	4 +7+13	180+21
V.M. No. 12347	219+3+(6)18	15–16/20–21	2+3? –	A	4F+6+11	174+21
Z.S.M. No. 18/1951	219+3+(7)18	17–19/20	2+4 –	A	4F+6+10	177+19
Z.S.M. No. 24/52A	226+3+(7)19	16/19–20	2+5 –	A	4 +6+12	169+18
Z.S.M. No. 24/52B	219+4+(7)x	17–18/22	2+5 –	A	4F+6+10	159+x
Z.S.M. No. 24/52C	222+3+(7)19	15–16/18–19	2+5 –	A	3F+6+13	158+17
K.M. No. R-4464	222+2+(6)19	18/19–21	2+5 +10	A	4F+6+11	166+18
K.M. No. R-4465	219+3+(7)19	14–15/18	2+5	A	4F+6+13	147+17
M.C.Z. No. 22158	218+3+(7)19	16–18/22	2+2?+11	A	4F+6+12	159+18
Z.S.M. No. 25/52	219+4+(7)20	16–18/20–21	2+6 –	A	4F+6+ 9	128+15
B.M. No. 1927.5.26.3	238+3+(7)20	18–19/19–21	2+5 –	A	4 +6+10	165+19
B.M. No. 1929.7.12.5	236+4+(7)21	17/19–20	2+5 –	A	4F+6+11	190+21
N.M.B. No. 3827	245+3+(7)23	16–17/17–19	2+6 –	A	4F+6+11	142+15
M.G. No. 1010.80	248+3+(8)21	17/20–21	2+5 –	A	4F+6+12	223+26
M.H.N.P. No. 0033	249+3+(8)22	16–18/18–20	2+2? –	A	4 +6+12	156+18

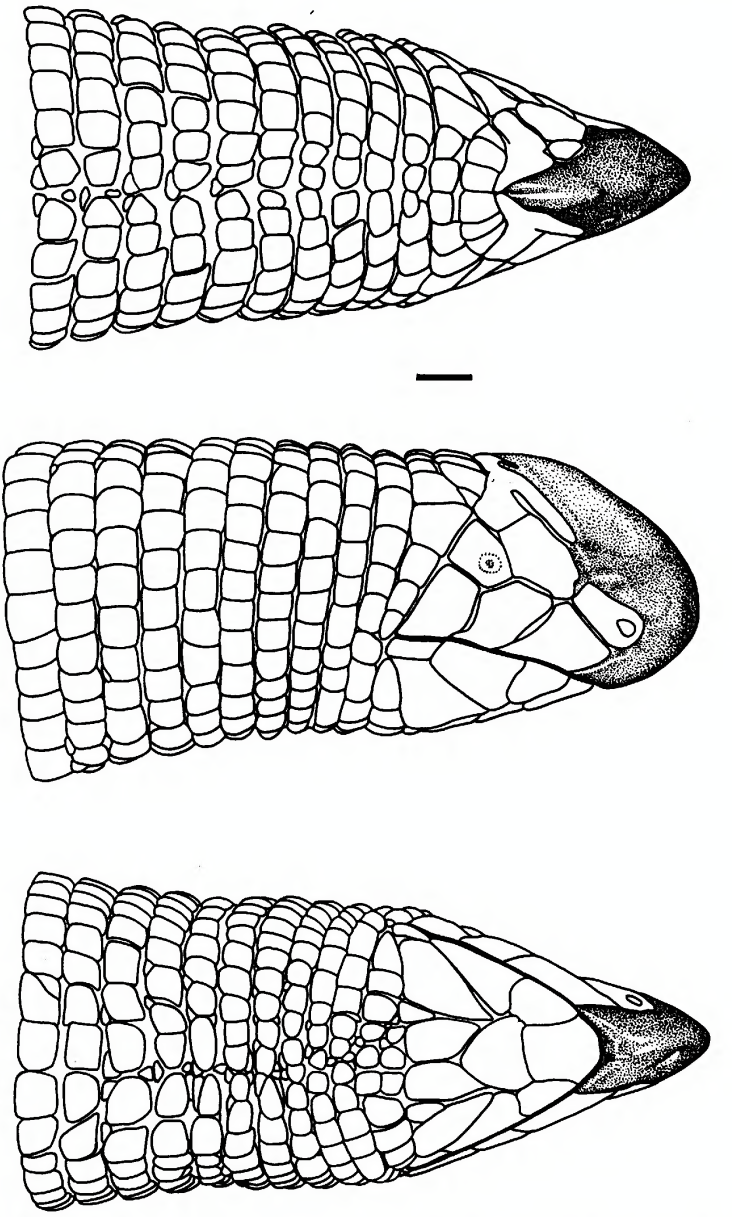

FIG. 3. Dorsal, lateral, and ventral views of head of *Anops kingi*, C.N.H.M. No. 80100, from Pôrto Alegre, Rio Grande do Sul, Brazil. Note enlargement of rostral caused by reduction of first row of segments between it and ocular (pattern B) and presence of a small, second, postgenial row. Keratinization indicated by stippling. Drawn by Virginia Cummings. Line equals 1 mm. to scale.

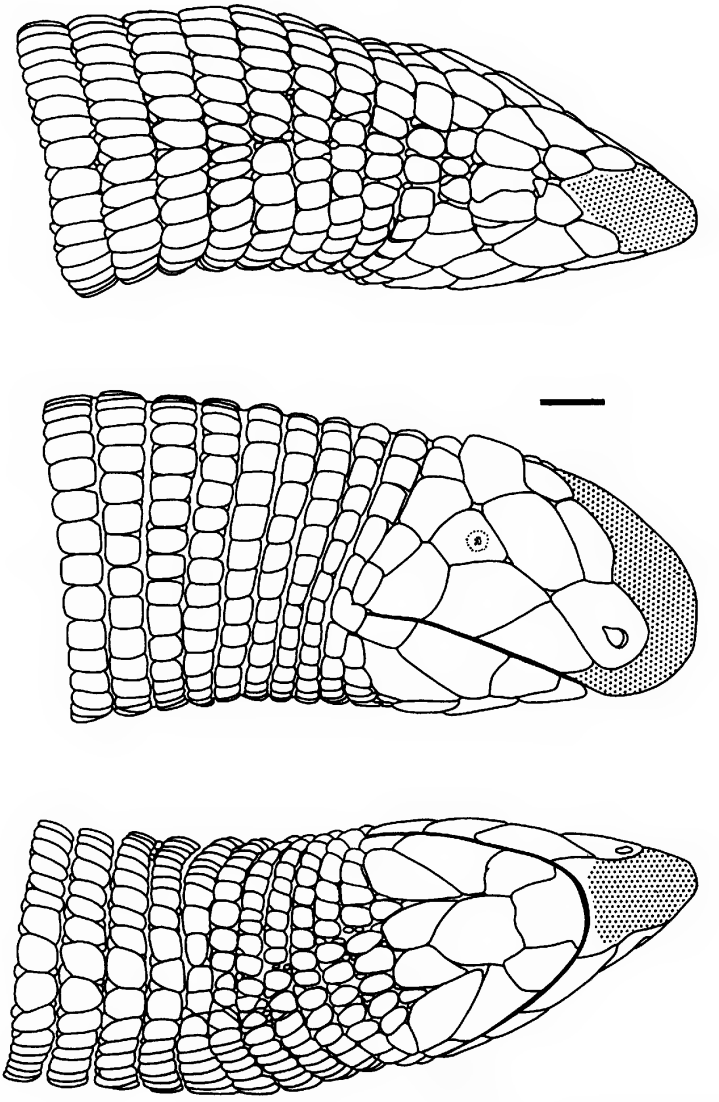

Fig. 4. Dorsal, lateral, and ventral views of head of *Anops kingi*, M.H.N.P. No. 0033, from "Patagonie," Río Negro, Argentina. Note presence of two rows of preocular segments, and irregularities in gular region. Drawn by Virginia Cummings. Line equals 1 mm. to scale.

Localities grouped in the center of the range show this as a minor fraction. Here the second row may be partially or completely suppressed, in many cases but not all, followed by a postmalar row.

No other characters show significant geographical variation.

The checkerboard of variation permits the assignment of samples to general regions. We have not attempted to correlate trends with changes in the physical environment. Such correlating is best done on the spot on the basis of samples that are more nearly adequate. The pattern we can demonstrate does not justify the recognition of infraspecific categories.

SEXUAL DIMORPHISM: Sexual dimorphism in amphisbaenids appears to be restricted to the degree of expression of the precloacal pores, which are generally much more evident in males. In *Anops* the ratio of specimens in which pores are clearly apparent to those with pores that are only faintly apparent (F in table 1) is greater than 2.5 to 1 for the entire

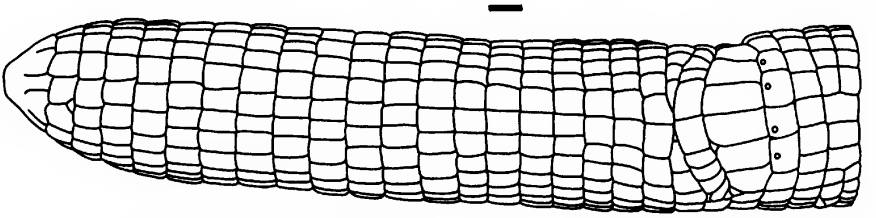

FIG. 5. Ventral view of cloaca and tail of a male of *Anops kingi*, B.M. No. 1927.5.26.3, from Bonifascio, Buenos Aires, Argentina. Drawn by Virginia Cummings. Line equals 1 mm. to scale.

sample and about 2 to 1 for the larger size classes. An examination of the gonads of the series in the Museum of Comparative Zoölogy reveals that only males with large testes and swollen convoluted ductuli deferenti have fully developed pores. A certain percentage of adults were clearly male but showed pores equivalent to those of females, i.e., with the secretion core reduced in diameter or absent.

The evidence suggests that the pores may be subject to seasonal variation, like the secondary sexual characters of a few other reptiles. There is also some indication that the size at sexual maturity may vary geographically, but this needs testing on series adequately documented with dates.

DESCRIPTION: Table 1 lists meristic characters. Figures 3 and 4 show the major variants of the head scalation. Figure 5 shows the segmentation of the cloaca and tail, and figures 6 to 10 show details of the color pattern, midbody segmentation, and the shape of the rostral keel. Figure 11 shows the body proportions.

Specimens are brown, with marked ventral countershading produced by a combination of dropping-out of the pigment by segments (an all-

FIG. 6. Dorsal, lateral, and ventral views of head of *Anops kingi*, C.N.H.M. No. 80100, from Pôrto Alegre, Rio Grande do Sul, Brazil. Note pigmentation pattern and keratinized keel.

or-none effect) and a reduction of pigment density. Considerable variation exists in the limits of the dark pigment. Some specimens have light-colored heads. Many show a light yellow caudal tip. Almost all have the ventral surface light from the gular region to the cloacal region. Many show some pigmented segments in the cloacal and postcloacal regions. The ventral surface of the tail from just behind the cloaca to in front of the caudal tip is often dark pigmented. Curiously enough, there is no tendency for distinct pigmentation of the autotomy annulus.

FIG. 7. Three-quarter view of the head of *Anops kingi*, C.N.H.M. No. 80100, from Pôrto Alegre, Rio Grande do Sul, Brazil, to show the vertical keel.

Head segmentation is characterized by the enormously enlarged rostral, covered in all but hatchlings by a thick transparent layer of keratin that forms the anterior keel of the animal. The rostral ascends from broad contact with the upper lip to a point approximately dorsal to the eye. Slightly anteriorly the dorsal level of the head may exceed that of the body. The nostrils pierce the nasals which adjoin the antero-dorsal surface of the large first supralabials. Two other supralabials follow these on each side, decreasing in size posteriorly, and with the angle of their sutures to the lip increasing posteriorly from approximately 30 degrees to 75 degrees. The ocular is quadratic to pentagonal and lies

between the dorsal edges of the second and third supralabials. Very few specimens have the last supralabials split, often unilaterally.

An irregular group of segments forms a single or double inclined row, anterodorsal to the ocular, and excluding it from contact with the rostral. The first row is narrower than the second and often formed of a single elongate segment that descends from the dorsal midline, but may or may not touch the nasal (thus producing two or one preocular row, respectively). The segments of the second row tend to be more squarish and irregular in number. This group of segments is probably homologous as a group to the prefrontal-frontal (-preocular) assemblage of the genus *Amphisbaena*. More detailed homologies are apt to be useless and tend to be invalidated by the extent of individual and geographic variation of these segments in *Anops kingi*. The angulus oris lies in a transverse plane that corresponds to the posterior edge of the first body annulus along the dorsal midline.

The mental is large, longer than wide, with spreading anterior edges. The first infralabials are but two-thirds of the size of the mental (in a very few specimens their medial tips are separated into a distinct scale); the second are much larger, in long contact with the labial edge, and send wings inward to touch the relatively small, shield-shaped postmental. The third infralabials are the smallest; much longer than wide, they give the impression of continuing beyond the angulus oris to interrupt the first body annulus. Two large malars are inserted behind and medial to the second and third infralabials; their anterior tips are in contact with the postmental. Medially, the postmental is followed by a pair of large, drop-shaped segments of the first postgenial row. Together the pair is larger than the postmental. Two specimens show a line of segments between the postgenials and the malars on one side and on both sides, respectively. Spaces between their rounded posterior edges and the medial edges of the malars are filled by the irregular segments of the second postgenial row. Though the midventral segments of the first body annulus often seem to adjoin the medial edge of the third infralabials, there are generally no postmalars. The first body annulus generally becomes very narrow or drops out altogether at the angulus oris. It is generally excluded from true infralabial contact by the posteriorly displaced edge of the malars. In a few specimens, this edge lacks such displacement, which results in a true postmalar row.

The dorsal half of the first body annulus swings slightly anteriorly. The annulus is V-shaped, and its anterior edge is generally directed to intersect the dorsalmost tip of the rostral. The middorsal segments are split and produce a short intercalated half annulus, four to six segments long,

which crosses the dorsum and remains in point contact with an ocular on each side. The second annulus has its edges in a plane approximately at right angles to the long axis of the animal.

The head has a marked vertical keel and is laterally compressed, so that the supralabials occupy the lateral extremity (fig. 7). The mid-chin shields (mental, postmental, first postgenials) are relatively large and

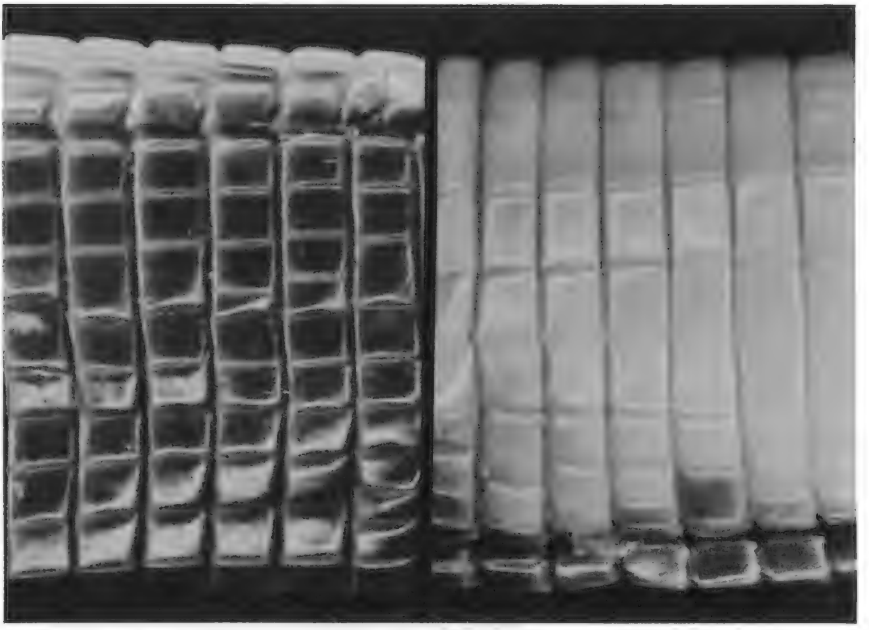

FIG. 8. Dorsal and ventral views at midbody of *Anops kingi*, C.N.H.M. No. 80100, from Pôrto Alegre, Rio Grande do Sul, Brazil, to show relative segmental proportions and pattern of pigmentation.

protruding. The lower jaw is much shorter than the upper; its tip does not reach the level of the nostril, and its edges are recessed into the upper jaw. The temporal muscles are faintly apparent. The nuchal region is only very faintly constricted, but the trunk widens noticeably beyond this point, so that the diameter of the head is less than that of the trunk. Many specimens have the head bent sharply to one or the other side.

There are 214 to 249 body annuli from the angulus oris up to and including the pore-bearing precloacals. The first eight are modified by being narrower; the middle ones of this series appear curved in dorsal view. Irregularities of body annuli are common. One or more are found in the cloacal region of almost every specimen, and among the first 15

postcephalics of approximately half the material. The irregularities commonly involve shifts in the alignment of segments at one of the sulci (or, not uncommonly, in mid-quarter). Such realignment may combine two more annuli into a single spiral. Ordinarily there are no intercalated dorsal half annuli. It is interesting to speculate on the functional basis for this difference from all previously examined species of *Amphisbaena*.

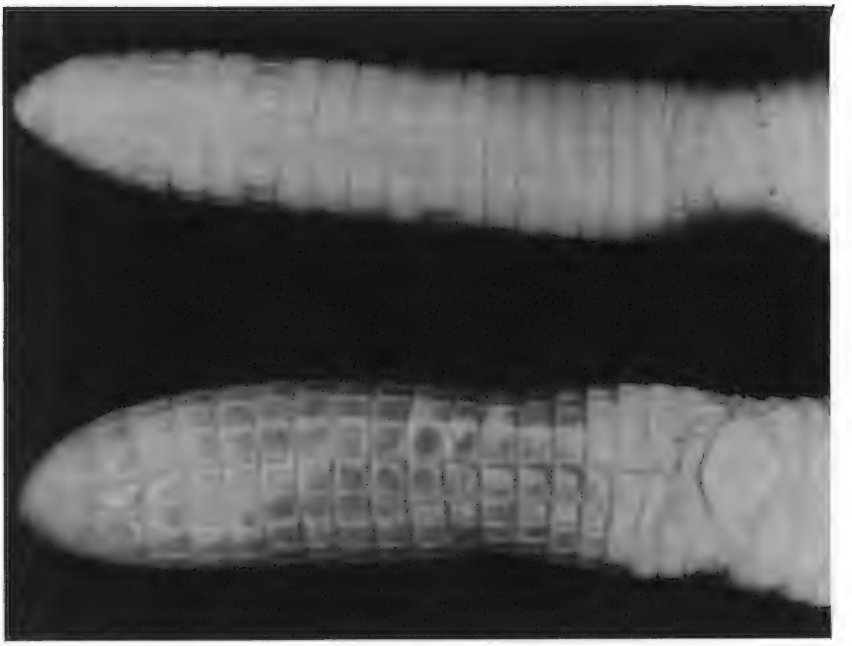

FIG. 9. Ventral views of the tails of *Anops kingi*, B.M. No. 1927.5.26.3 (top) and C.N.H.M. No. 80100, to show differential development of precloacal pores, possible irregularities of cloacal shield segments, and pigmentation pattern.

There are 12 to 19 dorsal, and 14 to 22 ventral, segments to a midbody annulus.

The cloacal region is characterized by four small, round, precloacal pores. As indicated above (under Sexual Dimorphism), these vary drastically in size. Five to nine (generally six) parallel-sided precloacals and nine to 16 (generally 11 to 13) postcloacal segments fringe the cloacal slit. The sixth, seventh, or eighth (generally the seventh) caudal annulus is modified by being slightly narrowed on the ventral, and markedly so on the lateral and dorsal, sides. The narrowed annulus serves as the site of autotomy. Only four out of 73 specimens (on which this could be

FIG. 10. Oblique view of tail of *Anops kingi*, C.N.H.M. No. 80100, from Pôrto Alegre, Rio Grande do Sul, Brazil, to show shape of extreme tip.

determined) had suffered loss of the tail at this level. One (A.N.S.P. No. 11354) had lost the extreme tip of the tail, apparently without activating the autotomy mechanism. Caudal annuli number 15 to 23, following after two to five (generally three or four) laterals. Lateral annuli are often asymmetrical, which confuses the counts. The autotomy annulus marks the site where the tail cross section changes from a horizontal ellipse to a vertical one, with a slight middorsal constriction to mark the attachment site of the muscle masses. The distal tip is hemiellipsoid to spheroid, without any lateral compression.

The lateral sulci are clearly marked and start after the first tenth of the body length. At midbody, each sulcus is as wide as or wider than one of the adjacent half-circular segments and is filled with broken segments. The dorsal sulcus is apparent on the back of the head and for the first fifth of the body; it is indicated only by a slight gap between the adjacent segments thereafter and becomes more noticeable near the cloaca and onto the tail. The ventral sulcus is not apparent in the first fifteenth of the body where the segments tend to be irregular; thereafter it is suggested by an alignment of intersegmental sutures.

The dorsal segments of a midbody annulus are approximately one and one-quarter to one and one-half times as long as wide, while the ventral segments range between one and one-quarter and one and one-half times as wide as long.

HABITS: This species is apparently capable of living in relatively hard soils, harder than those in which *Amphisbaena darwini* is found in Argentina (Birabén, 1954). The specimen from Mar Chiquita, Argentina, bears the notation "salt-swamp and bush" country on its label. Gallardo in-

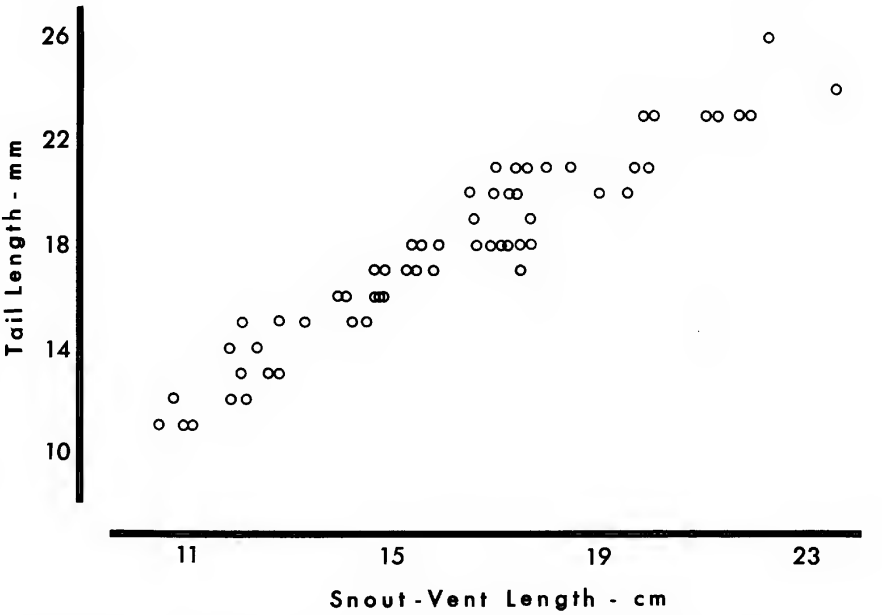

FIG. 11. *Anops kingi.* Scatter diagram of tail length versus snout-to-vent length for all material. The sample showed no significant geographical variation.

forms me (*in litt.*) that the specimen from Weisburd, Santiago del Estero, was taken in the fairly dense soil of a Chaco area at a depth of 2 meters, while the individual from Tanti, Cordoba, came from the nest of the ant *Acromyrmex lundi.*

The specimens from Santana, Brazil, were taken on a small hill under rocks in a grassy area, as were those from Mal Abrigo, Uruguay, and Hensel (1868) has commented that this species was taken near Pôrto Alegre, Brazil, only under rocks and boards (as were earthworms), but never in the forest proper.

A large series (more than 20) of specimens was taken by the senior

author at Montenegro, Rio Grande do Sul, Brazil, when plowing in sandy soil on an overcast day (November 20, 1963) after a period of steady rains. The plowshare was set at approximately 30 cm., but many specimens seemed to be within 10 cm. of the surface. The greatest concentrations were in slightly elevated areas, such as the berm of a road along a forest edge of eucalyptus planting. Many specimens were taken on a hillside in open pasture. In a poorly drained area near the coast at Travandaí, two additional specimens were taken adjacent to the root system of large cacti that were growing between plowed fields.

One individual (B.Y.U.C. No. 16149) has a deep but healed notch on its rostral keel.

Boulenger (1885a) commented on eggs (B.M. Nos. 85.2.3.6–85.2.3.7) sent in by Ihering from "ant's nests" in Rio Grande do Sul. The eggs were cylindrical, measured 35 by 10 mm. (actually 30 by 10 mm. and 35 by 10 mm.) and had a thin leathery envelope. In over-all length the hatchling measured 102+11 mm.

ANATOMY: The skull was figured diagrammatically by Parker (1942) and by Vanzolini (MS). Versluys (1898) discussed the extracolumella. Zangerl (1945) commented on the absence of a posterior girdle (cf. Camp, 1923, and Fürbringer, 1900) and described the vertebral column.

Smalian (1884) commented on the myology and general anatomy. Edgeworth (1935) mentioned the head muscles, and Camp (1923) noted that the dermal innervation was regular.

Butler (1895) and Milani (1894) referred to the complete reduction of the right lung in this species. Lynn and Komorowski (1957) described the thyroid, and Birabén (1954) commented on the histology of the eye.

LOCALITY RECORDS: No data: V.M. No. 500–6.

BRAZIL: Southern: (Amaral, 1937). "Eastern South America": (Burt and Burt, 1930); U.S.N.M. No. 17550. *Mato Grosso:* ?Caiçara: (Steindachner, 1867). *Rio Grande do Sul:* (Boulenger, 1885a); B.M. No. 85.2.3.5; D.Z. Nos. 277, 1276; S.U. Nos. 17291, 17303; U.R.G.S. No. 633. São Joao do Monte Negro (=Montenegro): (Boulenger, 1885b, 1886; Cope, 1885); A.N.S.P. No. 11354[1]; C.G. unnumbered; M.N.H.N. unnumbered. Travandaí: (two specimens). Pôrto Alegre: (Hensel, 1868; Strauch, 1881); C.N.H.M. No. 80100; D.Z. No. 3253; S.M.F. No. 11830;

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[1] This specimen bears a Cope collection tag with the printed statement "Peru . . . Prof. Orton." The tag bore the faint pencil marking "*Amphisbaena occidentalis*," and the number is recorded in the catalogue as a syntype of that species, which is clearly impossible.

Cope's only reference to *Anops* is in the 1885 report on the Rio Grande do Sul collection, most of which went to the Academy after his death. Since the Academy has no other specimen of *Anops*, we assume that we are dealing with a mislabeled specimen.

Z.M.U. Nos. 6829A, 6829B. São Leopoldo: D.Z. No. 6658. São Lourenço: (Boulenger, 1887); B.M. Nos. 86.3.10.2–86.3.10.6. Santa Maria: C.G. No. 1063; M.C.Z. Nos. 43360–43369; U.R.G.S. Nos. 1001, 1002. Rosario do Sul: D.Z. Nos. 6407, 6589, 6590, 6625–6631, 6678, 6679. Ten kilometers north of Santana: B.Y.U.C. Nos. 11466, 11468–11471, 11473–11475; K.U.M.N.H. No. 31677. Bage: M.R.C.N. No. 739.

PARAGUAY: (Bertoni, 1914, [1939]).

URUGUAY: Because of the density of records, the map (fig. 1) shows only a single locality for each department. M.A.C.N. No. 4569 (three specimens); M.C.Z. No. 3834. *Rivera:* Cerro del Chivos: M.N.H.N. unnumbered (five specimens). Vicinity of Rivera: Z.V.C.-R. No. 138. *Treinta-y-Tres:* Santa Clara de Olimar (=Olimar): Z.V.C.-R. unnumbered (six specimens); Nos. 259 (eight specimens), 286 (two specimens), 296. *Lavalleja:* Cerro el Penitente: M.N.H.N. No. 175; Z.V.C.-R. No. 170. Aguas Blancas: M.N.H.N. No. 711. Routa 8, Kilometer 844: M.N.H.N. unnumbered. Nico Perez (Bela Vista): C.G. Nos. 2209, 2210; M.N.H.N. Nos. 575, 577, 579–580, 582, 584, 587, 713. *Maldonado:* Barra del Arojo: M.N.H.N. No. 188 (six specimens). Punta del Este: M.N.H.N. No. 194. *Montevideo:* Montevideo: (Lichtenstein, 1856; Strauch, 1881); Z.M.U. No. 1387. Malven: M.N.H.N. unnumbered. *San José:* Sierra de Mahoma: Z.V.C.-R. Nos. 475 (two specimens), 478 (three specimens), 479. Three kilometers from Mal Abrigo: B.Y.U.C. Nos. 16148, 16149.

ARGENTINA: (Freiberg, 1939; Burt and Burt, 1930): Z.M.U. No. 11340. *Jujuy:* Palmar, Santa Barbara: M.A.C.N. No. 3555. *Salta:* Metan, La Población, Río Juramento: I.M.L. Nos. 310A–310D. Río del Valle, Departamento Anta: I.M.L. No. 254. Capiazzutti (Capilla Zuti): I.M.L. No. 17; M.A.C.N. unnumbered. *Tucuman:* Rumi Punco: M.A.C.N. No. 3097. *Santiago del Estero:* Weisburd: M.A.C.N. No. 2021. *Corrientes:* Manantiales: M.A.C.N. No. 3490. *Santa Fé:* Estancia "La Prusia," near Maria Eugenia: F.C.N.A.: (Hellmich, 1960); Z.S.M. Nos. 229/33A–229/33D. *Entre Rios:* La Paz, Arroyo Hondo: (Freiberg, 1939). Paraná: (Burmeister, 1861; Freiberg, 1939; Strauch, 1881). Aguas Corrientes, near Paraná: (Freiberg, 1939). Isla Ella: B.M. No. 1930.6.7.2. *Córdoba:* (Burt and Burt, 1930; Lieberman, 1937, 1939; Strauch, 1881); M.A.C.N. Nos. 222, 8392 (three specimens), 8559 (two specimens), 9128. Sierra de Córdoba: (Birabén, 1954). East of Mar Chiquita: H.M. No. 4607. Capilla del Monte: M.A.C.N. Nos. 2521, 3532 (two specimens). Jesus Maria: M.A.C.N. No. 3556. Cosquin: (Boulenger, 1885b); B.M. No. 83.4.14.10. Tanti, Departamento Panilla, near Cosquin: M.A.C.N. No. 350. Valle Hermoso: L.I.H.U.B.A. Nos. 250, 251. Altá Gracia:

M.A.C.N. No. 3747. El Sauce, Calamuchita: M.A.C.N. Nos. 1725, 2582. Achiras: A.M.N.H. Nos. 65186–65189. *San Luis:* Río Lugán: M.A.C.N. No. 1157. Las Isletas: M.A.C.N. No. 1025. *La Pampa:* Gral. Pico: M.A.C.N. No. 1023. Estancia La Vizcaina, between El Ondrey and Medano Leoncito, Departamento Limay Mahuida: M.A.C.N. unnumbered. *Buenos Aires:* H.M. No. 1940; K.M. Nos. R–4466, R–4467; V.M. No. 12347; Z.S.M. No. 18/1951. Pehuen, Partido Coronel Rosales: L.I.H.U.B.A. No. 1181. Isla Martín Garcia, in Río de la Plata at junction of Uruguay and Paraná: M.A.C.N. No. 1207. Buenos Aires: (Duméril and Bibron, 1839; Duméril, 1851; Strauch, 1881): Z.S.M. Nos. 24/52A–24/52C. Lanús: M.A.C.N. No. 1424. La Tinta: (Berg, 1884). Tandil: K.M. Nos. R–4464, R–4465; M.N.H.N. unnumbered (three specimens). Sierra de Tandil, near city: M.A.C.N. unnumbered (nine specimens), No. 2791 (15 specimens). Sierra de los Padres: Z.S.M. No. 25/52. Quequén: M.A.C.N. unnumbered (two specimens). Bonifacio: B.M. Nos. 1927.5.26.3, 1929.7.12.5. Bahia Blanca: (Müller, 1885); N.M.B. No. 3827. *Río Negro:* Río Negro de Patagonie: M.G. No. 1010.80. "Patagonie": M.H.N.P. No. 0033. *Neuquen:* M.A.C.N. No. 3474.

LITERATURE CITED

Amaral, Afranio do

1937. Estudos sobre lacertilios neotropicos. 4. Lista remissiva dos lacertilios do Brasil. Mem. Inst. Butantan, vol. 11, pp. 167–204, i–ix.

Bell, Thomas

1833. Mr. Bell exhibited specimens of two reptiles, forming part of his collection, which he regarded as the types of two genera hitherto undescribed. Proc. Zool. Soc. London, pp. 98–99.

1835. Description of a new genus of Reptilia of the family Amphisbaenidae. Zool. Jour., London, vol. 5, pp. 391–393.

Berg, Cárlos

1884. Reptiles y anfibios del Tandil y de La Tinta. Actas Acad. Nac. Cien. Córdoba, vol. 5, pp. 93–97.

Bertoni, A. de Winkelried

1914. Fauna paraguaya. Catálogos sistemáticos de los vertebrados del Paraguay. Asuncion, 86 pp.

[1939.] Fauna paraguaya. Catálogos sistemáticos de los vertebrados del Paraguay. Peces, batracios, reptiles, aves y mamíferos conocidos hasta 1913. Asunción, 86 pp.

Birabén, Max

1954. El ojo anópsico de anfisbénidos argentinos. Physis, vol. 20, no. 59, pp. 390–396.

Boulenger, George Albert

1885a. A list of reptiles and batrachians from the province Rio Grande do Sul, Brazil, sent to the Natural-History Museum by Dr. H. von Ihering. Ann. Mag. Nat. Hist., ser. 5, vol. 15, pp. 191–196.

1885b. Remarks on a paper by Prof. E. D. Cope on the reptiles of the province Rio Grande do Sul, Brazil. *Ibid.*, ser. 5, vol. 16, pp. 294–298.
1885c. Catalogue of the lizards in the British Museum (Natural History). Second edition. London, vol. 2, xii+497 pp.
1886. A synopsis of the reptiles and batrachians of the province of Rio Grande do Sul, Brazil. Ann. Mag. Nat. Hist., ser. 5, vol. 17, pp. 423–445.
1887. Catalogue of the lizards in the British Museum (Natural History). Second edition. London, vol. 3, xii+575 pp.

Burmeister, Hermann
1861. Reise durch die La Plata-Staaten, mit besonderer Rücksicht auf die physische Beschaffenheit und den Culturzustand der Argentinischen Republik. Ausgeführt in den Jahren 1857, 1858, 1859 und 1860. Halle, vol. 1, vi+503 pp.; vol. 2, vi+540 pp.

Burt, Charles E., and May Danheim Burt
1930. The South American lizards in the collection of the United States National Museum. Proc. U. S. Natl. Mus., vol. 78, no. 6, pp. 1–52.
1931. South American lizards in the collection of the American Museum of Natural History. Bull. Amer. Mus. Nat. Hist., vol. 61, art. 7, pp. 227–395.

Butler, Gerard W.
1895. On the complete or partial suppression of the right lung in the Amphisbaenidae and of the left lung in snakes and snake-like lizards and amphibians. Proc. Zool. Soc. London, pp. 691–712.

Camp, Charles L.
1923. Classification of the lizards. Bull. Amer. Mus. Nat. Hist., vol. 48, art. 11, pp. 289–481.

Cope, Edward Drinker
1885. Twelfth contribution to the herpetology of tropical America. Proc. Amer. Phil. Soc., vol. 22, pp. 167–194.

Duméril, André Marie Constant, and Gabriel Bibron
1839. Erpétologie générale ou histoire naturelle complète des reptiles. Paris, vol. 5, 855 pp.

Duméril, Auguste Henri André (*not* Duméril, André Marie Constant, and Auguste Henri André Duméril)
1851. Catalogue methodique de la collection des reptiles du Muséum d'Histoire Naturelle de Paris. Paris, iv+224 pp.

Edgeworth, F. H.
1935. The cranial muscles of vertebrates. Cambridge, ix+300 pp.

Freiberg, Marcos A.
1939. Enumeracion sistematica de los reptiles de Entre Rios y lista de los ejemplares que los representan en Museo de Entre Rios. Mem. Mus. Entre Rios, Zool., no. 11, pp. 1–28.
1958. Vida de batracios y reptiles sudamericanos. Buenos Aires, 192 pp.

Fürbringer, Maximillian
1900. Zur vergleichenden Anatomie des Brustschulterapparates und der Schultermuskeln. Jenaische Zeitschr. Naturwiss., vol. 34, pp. 215–718.

Gans, Carl, and A. Allan Alexander
1962. Studies on amphisbaenids (Amphisbaenia; Reptilia). 2. On the amphis-

baenids of the Antilles. Bull. Mus. Comp. Zoöl., vol. 128, no. 3, pp. 65–158.

GRAY, JOHN EDWARD
1844. Catalogue of the tortoises, crocodiles, and amphisbaenians with the description of some new species now in the collection of the British Museum. London, vii+80 pp.

HEMMING, FRANCIS (ED.)
1956. Opinion 417. Rejection for nomenclatorial purposes of volume 3 (Zoologie) of the work by Lorenz Oken entitled *Okens Lehrbuch der Naturgeschichte* published in 1815–1816. Opin. Declar. Internatl. Comm. Zool. Nomenclature, vol. 14, pt. 1, pp. 1–42.

HELLMICH, WALTER
1960. Die Sauria des Gran Chaco und seiner Randgebiete. Abhandl. Bayerischen Akad. Wiss., Math. Nat. Kl., new ser., no. 101, 131 pp.

HENSEL, REINHOLD
1868. Beiträge zur Kenntniss der Wirbelthiere Südbrasiliens. (Part.) Arch. Naturgesch., vol. 1, pp. 323–375.

KOSLOWSKY, JULIO
1898. Enumeracion systemática y distribucion geográfica de los reptiles Argentinos. Rev. Mus. La Plata, vol. 8, pt. 1, pp. 161–200.

LICHTENSTEIN, M. H. C.
1856. Nomenclator reptilium et amphibiorum Musei Zoologici Berolinensis. Namenverzeichniss der in der zoologischen Sammlung der königlichen Universität zu Berlin aufgestellten Arten von Reptilien und Amphibien nach ihren Ordnungen, Familien und Gattungen. Berlin, iv+48 pp.

LIEBERMANN, JOSÉ
1937. Catálogo sistemático y zoogeográfico de lacertilios Argentinos. Act. Secundo Congr. Argentino Cien. Nat., Mendoza, pp. 1–26.
1939. Catálogo sistemático y zoogeográfico de lacertilios Argentinos. Physis, vol. 16, pp. 61–82.

LYNN, W. GARDNER, AND LOUIS A. KOMOROWSKI
1957. The morphology of the thyroid gland in lizards of the families Pygopodidae and Amphisbaenidae. Herpetologica, vol. 13, no. 3, pp. 163–172.

MARELLI, CARLOS A.
1924. Elenco systemático de la fauna de la Provincia de Buenos Aires (Procordados y vertebrados). Mem. Minist. Obras Publ., Buenos Aires, 1922–1923, pp. 536–682, i–xxxi.

MILANI, A.
1894. Beiträge zur Kenntniss der Reptilienlunge. I. Lacertilia. Inaugural-Dissertation zur Erlangung der Doktor Würde der philosophischen Facultät der . . . Ludwigs-Univ. Giessen. Jena, 47 pp. *Also* Zool. Jahrb., Abt. Anat. Ontog. Thiere, vol. 7, pp. 545–592.

MÜLLER, FRITZ
1885. Vierter Nachtrag zum Katalog der herpetologischen Sammlung des Basler Museums. Verh. Naturf. Gesell. Basel, vol. 7, pp. 668–717.

OKEN, LORENZ
1815. Lehrbuch der Naturgeschichte. Leipzig, vol. 3, pt. 1, xxviii+850+xviii pp.

PARKER, HAMPTON WILDMAN
1942. The lizards of British Somaliland. Bull. Mus. Comp. Zoöl., vol. 91, no. 1, pp. 1–101.
RINGUELET, RAUL A., AND RAUL A. ARAMBURU
1957. Enumeracion sistemática de los vertebrados de la Provincia de Buenos Aires. La Plata, Minist. Buenos Aires, Minist. Asuntos Agrarios, no. 119, 94 pp.
SMALIAN, CARL
1884. Beiträge zur Anatomie der Amphisbaeniden. Inaugural-Dissertation Univ. Göttingen. Leipzig, 76 pp. *Also* Zeitschr. Wiss. Zool., vol. 42, pp. 126–202.
STEINDACHNER, FRANZ
1867. Reptilien. *In* Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859, unter den Befehlen des Commodore B. von Wüllerstorf-Urbair. Vienna, Zoologischer Theil, vol. 1, no. 3, 98 pp.
STEJNEGER, LEONHARDT
1916. Notes on amphisbaenian nomenclature. Proc. Biol. Soc. Washington, vol. 29, p. 85.
STRAUCH, ALEXANDRE
1881. Bemerkungen über die Eidechsenfamilie der Amphisbaeniden. Mel. Biol. Acad. Imp. Sci. St. Pétérsbourg, vol. 11, pp. 355–479. *Also* Bull. Acad. Imp. Sci. St. Pétérsbourg, vol. 28, no. 8, cols. 45–131.
VANZOLINI, PAULO EMILIO
1951. A systematic arrangement of the family Amphisbaenidae (Sauria). Herpetologica, vol. 7, no. 3, pp. 113–123.
[MS.] Evolution, adaptation and distribution of the amphisbaenid lizards (Sauria: Amphisbaenidae). Cambridge, Massachusetts, thesis submitted to Harvard University, 1951, 148 pp.
WIEGMANN, AREND FRIEDRICH AUGUST
1834. Herpetologia mexicana, seu descriptio amphibiorum novae hispaniae. Pars prima, saurorum species. Berlin, iv+54 pp.
VERSLUYS, JAN, JR.
1898. Die mittlere und äussere Ohrsphäre der Lacertilia und Rhynchocephalia. Jena, Inaugural-Dissertation . . . Universität Giessen, 247 pp.
ZANGERL, RAINER
1945. Contributions to the osteology of the post-cranial skeleton of the Amphisbaenidae. Amer. Midland Nat., vol. 33, no. 3, pp. 764–780.